

U.S. Application Serial No.: 10/628,925
Amendment Dated March 30, 2005
In Response to Office Action Dated December 30, 2004

REMARKS

Claims 1-50 are in this application.

Claim 32-50 have been canceled without prejudice or disclaimer. Claims 32-50 have been canceled because they are drawn to a non-elected invention.

Claims 1-31 are currently pending in this application.

Applicants gratefully acknowledge the allowability of claims 10-14 if written in independent form including all the limitations of the base claim and any intervening claims.

Claims 1-9 and 15-19, 21, and 25-31 have been rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 6,265,780 to Yew et al., herein after "Yew."

Claims 1-9 and 15-19, 21, and 25-31, distinguish over Yew as follows:

(1) The electrical interconnect structure according to claim 1 has:
a first low k or ultra low k dielectric layer;
a low k CMP protective layer disposed on the first low k dielectric layer;
and
a CVD hardmask/CMP polish stop layer.

In contrast, in the structure described by Yew, the protective layer goes on the etch stop layer, not directly on the first dielectric layer, as is the case in the instantly claimed invention (see claim 1).

(2) The low k protective layer 208 described by Yew is never in contact with CMP. For example, Figure 2E shows a metallized structure just after CMP. In the structure described by Yew, the only materials near the top that could be exposed to CMP are 214, which is described by Yew as being "a high-K inorganic dielectric material" (see column 4, lines 47-50), and 216, which is described by Yew as being "a second photoresist" (see column 4, lines 50-57). However, neither 214 nor 216 is a low k dielectric material.

The Office Action refers to 206 as being a protective layer. This is incorrect. 206 is actually an etch stop layer in Yew (for example, see column 4, lines 13-28):

Optionally a protective layer 208 can be formed over the etch-stop layer 206 from a selected dielectric material having a higher dielectric constant than the dielectric material used to form the etch-stop layer 206, such as oxide, silicon-oxy-nitride, or silicon nitride. This protective layer 208 can help prevent the etching rate on the second dielectric layer 212 (to be formed later) to be nearly equal to the etching rate on the etch-stop layer 206 during the subsequently performed etching process, and thus prevent the etch-stop layer 206 from being damaged during the etching process. After the protective layer 208 is formed, the next step is to form a first photoresist layer 210 over the protective layer 208, which is selectively removed to expose a selected area of the protective layer 208 that is laid directly above the base metal interconnect structure 202.

Accordingly, the structures described by Yew are entirely different than the instantly claimed structures.

(3) In the instantly claimed invention, the protective layer is a CMP protective layer, not an etch protective layer. The protective layer in the final interconnect structure is never exposed to Etch, except in the lines and vias where it is completely removed by etch.

(4) The protective layer described by Yew is a high dielectric constant material, rather than the low dielectric constant layers in the instantly claimed invention.

(5) Yew does not describe any materials that can covalently bond to form improved adhesion. The materials listed by Yew as the first organic dielectric material and as the etch stop layer do not have the necessary chemical structure to form covalent bonds between the materials.

There is no teaching or disclosure in Yew that the first organic dielectric material and any of the other materials they list for etch stop layers forming covalent bonds.

Clearly, Yew does not contemplate forming covalent bonds between these materials. To form chemical bonds with the organic dielectric layer, a reactive organic functional group is required in the inorganic layer. The structures described by Yew clearly do not have reactive organic functional groups in the inorganic layer. Thus, the structures described by Yew are entirely different from the instantly claimed structures.

Therefore, the rejection of claims 1-9 and 15-19, 21, and 25-31 under 35 U.S.C. 102(b) as being anticipated by Yew should be withdrawn and claims 1-9

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and 15-19, 21, and 25-31, and the claims directly or indirectly depending therefrom, should be allowed.

Claims 20 and 22-24 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Yew in view of U.S. Patent No. 6,683,002 to Chooi et al., herein after "Chooi."

Claims 20 and 22-24 depend from claim 1 and, as such, they have all the features and limitations of claim 1.

As mentioned above, instant claims 20 and 22-24 differ from Yew and Chooi as follows:

(1) In the structure described by Yew, the protective layer goes on the etch stop layer, not directly on the first dielectric layer, as is the case in the instantly claimed invention (see claim 1).

The same deficiency exists in Chooi.

Chooi does not describe a CMP protective layer.

(2) The low k protective layer 208 described by Yew is never in contact with CMP. For example, Figure 2E shows a metallized structure just after CMP. In the structure described by Yew, the only materials near the top that could be exposed to CMP are 214, which is described by Yew as being "a high-K inorganic dielectric material" (see column 4, lines 47-50), and 216, which is described by Yew as being "a second photoresist" (see column 4, lines 50-57). However, neither 214 nor 216 is a low k dielectric material.

The Office Action refers to 206 as being a protective layer. This is incorrect. 206 is actually an etch stop layer in Yew (for example, see column 4, lines 13-28):

Optionally a protective layer 208 can be formed over the etch-stop layer 206 from a selected dielectric material having a higher dielectric constant than the dielectric material used to form the etch-stop layer 206, such as oxide, silicon-oxy-nitride, or silicon nitride. This protective layer 208 can help prevent the etching rate on the second dielectric layer 212 (to be formed later) to be nearly equal to the etching rate on the etch-stop layer 206 during the subsequently performed etching process, and thus prevent the etch-stop layer 206 from being damaged during the etching process. After the protective layer 208 is formed, the next step is to form a first photoresist layer 210 over the protective layer 208, which is selectively removed to expose a selected area of the protective layer 208 that is laid directly above the base metal interconnect structure 202.

Accordingly, the structures described by Yew are entirely different than the instantly claimed structures.

The same deficiency exists in Chooi.

Chooi describes using a porous dielectric layer in an interconnect structure but Chooi does not describe a porous low k dielectric layer that is exposed to CMP or acts to protect another low k layer from any damage from CMP.

The only layer exposed to CMP in Chooi is layer 22 which is described as a cap. This layer is not low k or porous and is much thicker than the proposed protective layer (see column 3, lines 60-65):

Finally, a cap layer 22, which is also optional, can be formed on dielectric layer 20. The cap layer is preferably composed of silicon nitride, silicon oxynitride, silicon carbide or boron nitride and most preferably silicon nitride. The cap layer preferably has a thickness of between about 500 and 5,000 Å.

The only materials near the top that could be exposed to CMP are those referred to as 22, and described by Chooi as being "silicon nitride, silicon oxynitride, silicon carbide or boron nitride."

These are not porous or low k materials.

(3) In the instantly claimed invention, the protective layer is a CMP protective layer, not an etch protective layer. The protective layer in the final interconnect structure is never exposed to Etch, except in the lines and vias where it is completely removed by etch.

The same deficiency exists in Chooi.

Chooi does not describe a CMP protective layer, they only describe that the dielectric layer may be porous.

(4) The protective layer described by Yew is a high dielectric constant material, rather than the low dielectric constant layers in the instantly claimed invention.

The same deficiency exists in Chooi.

Chooi does not describe a protective layer. The only layer that could be exposed to CMP in Chooi is layer 22 which is not porous or low k.

(5) Yew does not describe any materials that can covalently bond to form improved adhesion. The materials listed by Yew as the first organic dielectric material and as the etch stop layer do not have the necessary chemical structure to form covalent bonds between the materials.

There is no teaching or disclosure in Yew that the first organic dielectric material and any of the other materials they list for the etch stop layer forming covalent bonds. Clearly, Yew does not contemplate forming covalent bonds between these materials. To form chemical bonds with the organic dielectric layer, a reactive organic functional group is required in the inorganic layer.

The same deficiency exists in Chooi.

The structures described by Yew clearly do not have reactive organic functional groups in the inorganic layer. Thus, the structures described by Yew are entirely different from the instantly claimed structures.

In view of the above, Yew and Chooi, either alone or in combination, do not possess all the elements of the interconnect structure defined by claim 1.

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Even if Yew and Chooi are combined, the resulting structure would still be deficient in describing the interconnect structure as defined by claim 1.

To establish a *prima facie* case of obviousness, all the elements of a claim must be present or described in a cited references with a suggestion to modify the references, to provide motivation to combine (see MPEP § 2142 and In re Rouffet, 47 USPQ 2d at 1457-1458) and arrive at the claimed invention, provided that a person of ordinary skill in the art would have a reasonable expectation of success.

Yew and Chooi, either alone or in combination, do not possess all the elements of the interconnect structure defined by claim 1.

There is no teaching or suggestion in either Yew or Chooi regarding how to modify one or more elements of the other to produce an interconnect structure as defined by claim 1. Further, there is no teaching or suggestion in Yew and Chooi **in combination** regarding how to produce an interconnect structure having **all the limitations** required by claim 1.

Without such a teaching or suggestion to modify the reference, a person of ordinary skill in the art would not have motivation to combine the references.

Further, even if the references were combined, a person of ordinary skill in the art would not have a reasonable expectation of success at arriving at the claimed invention, because Yew and Chooi, in combination, still do not describe an interconnect structure having all the elements as defined by claim 1.

Thus, the combination of the cited art does not render the instant claims obvious because Yew and Chooi even in combination:

- (1) does not have all the elements of claim 1;
- (2) does not provide a teaching or suggestion on how to modify the references;
- (3) does not provide motivation to combine the references; and
- (4) does not provide a reasonable expectation of success in arriving at the instantly claimed invention.

Thus, if when Yew and Chooi are to be combined, they still do not, in combination, describe an interconnect structure having all the elements of the interconnect structure as defined by claim 1.

Accordingly, the criteria for establishing a *prima facie* case of obviousness have not been met (see MPEP 2143, citing *In Re Vaeck*, 947 F.2d 488, 20 USPQ 2d 1438 (Fed. Cir. 1991)).

In the absence of a *prima facie* case of obviousness being established, the instantly claimed interconnect structure is unobvious over the combination of the cited references, namely over Yew in view of Chooi.

Therefore, the rejection of claims 20 and 22-24 under 35 U.S.C. 103(a) as being unpatentable over Yew in view of Chooi should be withdrawn and claims 20 and 22-24 should be allowed.

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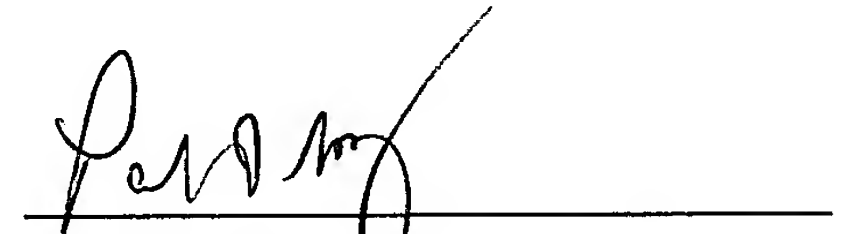
In view of the foregoing, all currently pending claims, namely claims 1-31, are patentable over the cited art for at least the reasons set forth herein above.

Reconsideration of this application, withdrawal of the rejections and allowance of claims 1-31 is respectfully requested.

Respectfully submitted,

Date: March 30, 2005

By:

A handwritten signature in black ink, appearing to read "Paul D. Greeley", is written over a horizontal line.

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